The evaluation of diffusion layers by destructive and non-destructive methods

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High-stressed machine parts, such as barrels, are usually made of steels, while wear and erosion has been a limiting factor in barrels performance since their invention. The most frequently used materials for high-stressed parts as barrels or gears are CrMoNi or CrMoV steels. Currently, modified chemical heat treatment processes, such as plasma nitriding or ferritic nitrocarburizing, are widely used to enhance the properties of barrels and gears. Generally, the term plasma nitriding also means a surface treatment of material, when the use of the plasma process cause gradual saturation of the surface of components by nitrogen comprised in the gas under predetermined temperatures and pressures. Nitrides occur inside the material as a result of the nitriding process. However, there are some exceptions regarding to Cr steels. Due to the diffusion process during nitriding, there is an absence of chromium nitrides and carbides in the surface layer. The absence of chromium in solid solute by precipitation of chromium nitrides and carbides leads to significant decreases in corrosion resistant. The aim of the nitriding process is to achieve an enhanced surface hardness, better wear resistance, reduced friction coefficient, increase fatigue limit and corrosion resistance. The aim of the presented paper is to study the effect of chemical composition, esp. chromium, molybdenum, manganese concentration, and microstructure of Fe-C-j steels on the mechanical and tribological properties. Moreover, there is necessary to evaluate the created layer after diffusion technology by non-destructive methods. It is generally known that the process of nitriding significantly influences the dimensional accuracy and surface topography what is the fundamental knowledge.

After nitriding process the samples were cut because of evaluation of microhardness and metallographical testing. Nitrided layers were evaluated by metallographic method on 3D optodigital microscope OLYMPUS DSX 500i and SEM Tescan Vega 3. The chemical composition was evaluated by GDOES method on spectrometer LECO surface analyzer and the depth of diffusion layer is measured by microhardness method on automatic microhardness tester LM 247 AT. ROLLSCAN 200 with special long slim sensor based of Barkhausen Noise Analysis (BNA) was used for non-destructive analysing of surface parameters of compact cavity as well. The length and depth of nitriding layers (Nht thickness) which were created at the same condition in steel 42CrMo4 and 32CrMoV12-10 was compared and separately evaluated both destructive and non-destructive methods.

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